















IV.—ON THE FOOD OF THE HALIBUT, WITH NOTES ON  
THE FOOD OF *SCORPÆNA*, *PHYCIS BLENNOIDES*,  
THE GARPIKE AND *CHIMÆRA MONSTROSA*. By  
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The stomachs of over one thousand specimens of halibut, *Hippoglossus vulgaris* (Flem.), have been examined during the period from September 1909 to June 1910. The sizes of the halibut ranged from 18 inches to 5 feet in length. They were captured in various parts of the North Sea and North Atlantic, and landed at the Aberdeen Fishmarket, and I desire to acknowledge my indebtedness to the fish merchants there who so kindly supplied the material for this research, and for the data concerning the sizes of the specimens supplied.

It has been my experience, as it is the experience of others when engaged in a research of this kind, that even under the most favourable conditions a certain percentage of the fishes examined have either no food in their stomachs, or it is so much broken up and decomposed by the action of the gastric fluid—an action that does not cease till some time after the death of the fish—as to be indistinguishable.

Of the halibut stomachs examined, about one-third, or nearly 34 per cent., were found to be empty, or the nature of the food could not be determined, which leaves about seven hundred, the contents of which could in some measure at least be identified.

#### THE FISHES.

A large proportion of the food observed consisted of Gadoids, chiefly haddocks and whittings; Norway pout (*Gadus esmarkii*) were also met with on several occasions. On the other hand, codfish and brassies were rarely noticed. Flat fishes, such as long rough dabs, were sometimes obtained, but not very often, and once or twice a lemon sole and witch soles occurred.

#### THE CRUSTACEA.

Crustacea were tolerably frequent, especially in the stomachs of the smaller halibut, but they also occurred in those of the larger examples. In the case of some of the larger halibut it was apparent that little effort had been exerted to crush the crustaceans found in their stomachs; specimens, almost complete, of tolerably large crabs like *Geryon tridens*, *Lithodes maia* and *Munida bamffica*, their carapace only being somewhat softened by partial digestion, being present. Small crabs like *Hyas coarctatus* and *Atelecyclus septemdentatus*, but especially the former, were by no means rare, several of them being scarcely injured except that the shell was slightly softened. Norway lobsters (*Nephrops norvegicus*) were frequent, both in the stomachs of large and small fishes, full-grown as well as young specimens being moderately frequent, and not a few of the smaller as well as the larger examples having apparently been swallowed whole, only the shell being slightly softened and shrivelled. *Nephrops* and hermit crabs—especially *Eupagurus bernhardus*—were the more common among the crustacea observed.



## MOLLUSCA.

With the exception of one or two species of Cephalopoda, Mollusca were rarely met with, the only species of shell-fish observed being *Fusus antiquus*, which occurred on one or two occasions; the halibut did not apparently take the whole shell, but simply snapped off the extended head as far as it reached beyond the protecting shell. The operculum of one *Fusus*—a large specimen—taken thus unawares, measures across the longest diameter 60 millimetres by about 33 millimetres at the widest part. But though shell-fish were rare, Cephalopods were tolerably frequent, though sometimes the brown horny jaws were all that was left to represent the cuttlefish—the soft body having rapidly succumbed to the solvent action of the gastric fluid. In several cases, however, fairly complete specimens were obtained, showing that the cuttlefish had been swallowed whole, the body first, with the tentacles streaming behind, as was apparent from the position of the organism in the stomach. The cuttlefishes observed belonged to three, or perhaps four genera, viz., *Loligo*, *Eledone* (and probably *Octopus*), and *Ommatostrephes*. The *Eledone* and *Octopus* are Octopods—that is, they are provided with eight tentacles; they differ in the *Eledone* having tentacles with a single row of suckers and the *Octopus* with a double row—the suckers of the one row alternating with those of the other. This, which is one of the more obvious differences between the two, is in the case of a partly digested specimen somewhat difficult to make out. The specimens, however, which were sufficiently perfect for identification were found to be *Eledones*—probably *Eledone cirrrosa*. Several specimens of *Loligo* were observed, but with the exception of perhaps one or two, they all belonged to *Loligo vulgaris* (Lamarck). None of them appeared to be full grown, and the shell (or bone) of the largest specimen measured only  $7\frac{7}{8}$  inches (about 20 centimetres) in length, and  $1\frac{3}{8}$  inches (3.5 centimetres) in width at the widest part. The shell of a smaller specimen was rather narrower in proportion to the length; this one measured fully  $4\frac{1}{4}$  inches (110 mm.) by  $\frac{5}{8}$  of an inch (16 mm.) in width. *Ommatostrephes* was represented by a piece of the anterior end of the shell (or bone) of a specimen of moderate size.

## THE ECHINODERMATA.

The Echinodermata were only sparingly represented by fragments of *Spatangus* and a nearly complete but crushed specimen of *Cidaris papillata*. The discs and arms of a few Ophiurids were also observed, but these were probably derived from the stomachs of Gadoids which the halibut had swallowed.

## THE ANNELIDS.

Traces of Annelids (*Chaetopods*) were observed in a few stomachs, but these, like the Ophiurids mentioned above, may have come from the stomach of a fish swallowed by the halibut.

## TABLE SHEWING NUMBER OF FISHES EXAMINED.

The following is a tabulated summary of the total number of stomachs examined each month, the number containing food that could be identified, and the number empty, or the contents of which could not be determined:—

[TABLE.]



Months when the Stomachs were examined.	Total number of Stomachs examined each month.	Number with food that could be identified.	Number empty, or with food that could not be determined.
September 1909	21 stomachs	12 stomachs	9 empty
October „	115 „	74 „	41 „
November „	101 „	53 „	48 „
December „	167 „	117 „	50 „
January 1910	91 „	59 „	32 „
February „	160 „	125 „	35 „
March „	83 „	68 „	15 „
April „	124 „	84 „	40 „
May „	95 „	60 „	35 „
June „	119 „	62 „	57 „
Totals for the ten months.	1076 „	714 „	362 „

It will be observed from the preceding table that the total number of halibut stomachs examined was 1076, and of these 362 (about 33·7 per cent.) were empty, or the nature of the contents could not be determined, while the remaining 714 contained food which consisted of organisms that could at least to some extent be identified.

It will also be observed that during the several months the proportion of empty stomachs differed sometimes considerably; this difference, however, may not be due to natural causes. Sometimes it could be explained by the fact that some of the stomachs available for examination were those of “welled fish”—fish which had been on the ship for a number of days, and kept alive in a tank fitted up for the purpose in the ship’s hold; any food, therefore, the stomach may have contained would be more or less completely digested by the time they were brought to the market. Sometimes also the food may have consisted of only soft-bodied organisms, such as cuttlefishes, which are quickly reduced to unrecognisable pulp; in other cases, the only evidence that the fish had recently been feeding was the presence in the intestine of partially eroded otoliths, or other less digestible substances.

In comparing the food contents of the stomachs examined from month to month, slight differences in the constituents of the food have also been observed. For a while crustacea, especially such forms as hermit crabs (*Eupagurus*) and *Nephrops*, were of frequent occurrence, but in the latter months, *i.e.*, from March onwards, crustacea have not been so often met with; while on the other hand, Gadoids, such as haddocks and whittings, but other fishes as well, have constituted the principal part of the food, and sometimes was the only kind observed.

In the following summarised statement a description of the food observed in the stomachs during each of the ten months from September 1909 to June 1910 inclusive, is given.

#### September 1909.

Twenty-one halibut stomachs were examined in September, and of these 12 contained food that could be identified. The food in one of them consisted of fragments of *Spatangus purpurea* and *Fusus*, that of another consisted of starfish discs and arms. In a third the food consisted of remains of fish and a Decapod crustacean, while the contents of the others consisted entirely of fishes, among which were the remains of haddocks and whittings and a fairly large herring.



## October.

The stomachs examined in October numbered 115, and 74 of these contained food. The length of the halibut examined ranged from 20 to 50 inches, but only a few were over 36 inches in length, and the food contents of the larger did not differ in any marked degree from those of the smaller examples. The contents of between fifty and sixty of the stomachs consisted for the most part of crustacea or of fish. Small cuttlefishes constituted the food of about half-a-dozen stomachs, but in the remainder the contents were mixed crustacea and fish, with sometimes a small cuttlefish. The fishes that could be distinguished by their earstones or otherwise were chiefly Gadoids (haddock and whiting) and herrings; the remains of a few flat-fishes were also observed, but the species could not be determined.

The crustacea consisted largely of *Nephrops norvegica*, *Munida bamffica*, and *Eupagurus bernhardus*; several of the *Nephrops* were large, full-grown specimens, measuring over all 8 inches to fully 9 inches in length. In one of the stomachs examined twenty-one specimens of *Munida*, large and small, were counted; in another a nearly complete *Geryon tridens* occurred, but the shell bore evidence of the solvent power of the gastric fluid; while in a third a tolerably large soft-shelled female *Lithodes* was obtained. A few specimens of *Hyas coarctatus* and *Portunus* sp. were met with, while in one stomach, containing a mixed lot of food, the contents consisted of *Nephrops*, small fishes, and a number of tolerably large isopod parasites, *Cirolana borealis*, which are not uncommon on Gadoids in the North Sea, and are described by G. O. Sars as being among the most effective scavengers of the sea, and also as doing injury to the fishes caught on the fishermen's lines when not quickly removed.

## November.

The number of stomachs examined in November was 101, and of these 53 contained food. Most of the halibut ranged from two to three feet in length, but four or five of them measured four feet in length and three five feet.

Crustacea (*Portunus*, *Atelecyclus septemdentatus*, *Eupagurus* sp., *Nephrops*, and *Munida*), together with young fishes, formed the principal portion of the food of smaller halibuts, but the food of the larger individuals consisted chiefly of fishes. In the stomach of one of these larger examples the earstone of a tolerably large hake was obtained; the earstone measured 25 mm., and the fish it belonged to could not, therefore, have been less than about 22 or 23 inches in length. For the purpose of comparison, it may be stated that the length of the earstones of a hake 16 inches long measure nearly 17 mm., and those of one 14½ inches 16 mm.\* Other fishes observed included a whiting 11 inches long, partly digested; a tolerably large codling, remains of haddocks, a few long rough dabs, and sand-eels. One stomach contained five small flat-fishes, the jaws of a cuttlefish, remains of *Nephrops*, and a few parasitic *Cirolana borealis*. Another was full of hermit crabs (probably *Eupagurus bernhardus*), while a third contained six or seven specimens of *Munida bamffica* and a small stone. Seventeen of the stomachs contained fish only, 13 contained crustacea only, and the contents of other ten consisted of a mixed lot of crustacea and fish, including also the remains of small cuttlefishes; while the food contents of three consisted of cuttlefishes only.

## December.

The number of stomachs examined in December was 167, and 117 of these contained food that could to some extent be identified. With the exception of eleven, the food observed in these stomachs consisted entirely either of

\*Twenty-fourth Ann. Rept., Part III., p. 66 (1906).



fishes (Gadoids chiefly) or of crustacea (chiefly *Eupagurus bernhardus*, but one or two other species of *Eupagurus*, *Nephrops*, etc., were also occasionally present). The stomachs containing crustacea only, numbered about 65, and those containing fish only, numbered about 43. In eight halibut stomachs the food contents included a whiting and one or two small shell-fish. Another contained the remains of four or five *Munida bamffica* and a small cuttlefish (*Eledone*), while a third contained *Nephrops* and *Gadus* (?) *esmarkii*. The entire contents of one stomach consisted of cuttlefish, one contained Annelids only, and one part of a large *Fusus antiquus*.

The Gadoids met with most frequently consisted for the most part of haddocks and whittings, a few of which were of fairly large size and measured 10, 11, and 12 inches in length. The remains of herrings were also occasionally noticed; one stomach contained a herring 9 inches long and a fairly large cuttlefish—*Loligo vulgaris*. Another contained a herring about 7 inches long, which was sufficiently perfect to show that it had been feeding largely on the Schizopod *Thysanoessa neglecta* before being captured by the halibut.

Among the crustacea observed, the hermit crab (*Eupagurus bernhardus*) was, as stated above, the more common form, but one or two specimens of *Eupagurus pubescens* and *Eupagurus cuanensis* also occurred. The few *Portuni* observed were limited to *P. holasatus* and *P. depurator*. Two of the stomachs examined in December contained each a specimen of *Geryon tridens*, and one or two small *Atelecyclus* were also noticed.

#### DIFFERENCES IN THE FOOD OF LARGE AND SMALL FISHES.

The only appreciable difference that could be observed in the food of the larger halibut was that fishes appeared to be more frequently consumed, while the smaller preyed more upon crustacea.

The stomachs examined in December were, for the most part, from halibut three feet in length, and only a few from specimens over that size.

#### January 1910.

In January 1910, 91 halibut stomachs were examined, and 59 of these contained food that could be identified; none of the halibut were over three feet in length. The food contained in 31 of the stomachs consisted entirely of fishes, 19 contained crustacea only, while in the remaining 11 the food consisted partly of fish, partly of crustacea, and also occasionally with the remains of small cuttlefish.

#### FISHES.

The fishes observed belonged, for the most part, to the Gadoids, chiefly haddocks and whittings, some of which were of tolerable size. In one stomach the remains of two haddocks between 10 and 11 inches long were observed, and a whiting 14 inches in length occurred in another, while in a third there were two specimens of a coal-fish partly digested, the length of which would be about 12 to 15 inches, but these were rather exceptional occurrences. Other fishes observed included one or two Brassies, a few Norway pouts, and the remains of what appeared to be a lemon sole, but the fish was too much digested to be satisfactorily identified; sand-eels were also frequently met with in the stomachs of the smaller halibuts. In the stomach of one of these I found a Pogge (*Agonus cataphractus*),  $4\frac{1}{2}$  inches long and nearly perfect, its hard scaly covering being nearly impervious to the solvent action of the gastric fluid.



## CRUSTACEA.

The crustacea most frequently observed were *Nephrops norvegicus*, hermit crabs, chiefly *Eupagurus bernhardus*, *Portunus depurator*, and one or two other species such as *Corystes cassivelaunus*, *Hyas coarctatus*, small *Galathea* sp., and *Pandalus montagui*. In one stomach no fewer than a dozen small *Corystes cassivelaunus* were counted, while some of the *Nephrops* and hermit crabs observed were of fairly large size.

## CUTTLEFISHES.

Cuttlefishes were rarely met with in the stomachs examined in January, and those observed appeared to be *Eledones*. No Annelids nor starfishes were observed.

## February.

The number of halibut stomachs examined in February was 160, and of these 125 contained food; the others were empty, or their contents could not be identified.

A considerable proportion of the halibut were small, being under 3 feet in length, and only a few of them were from 3 to 3½ feet long.

Fishes—Gadoids and sand-eels for the most part—formed the only food observed in nearly sixty per cent. of these, and the stomachs in which crustacea alone constituted the food contents amounted only to a little over nine per cent. On the other hand, the number that contained a mixture of crustacea, fish, and other organisms was larger in proportion than in the previous months. Cuttlefishes were also much more frequently met with.

## FISHES.

As indicated above, the fishes observed consisted chiefly of whittings, haddocks, and sand-eels, several of the former being tolerably large. One of the stomachs, for example, contained a fairly large haddock 18 inches long and a small one 8 or 9 inches; another stomach contained two whiting, and, judging by the size of their earstones, both were at least 15 inches long. The occurrence of such large specimens was, however, exceptional; the sizes of haddock and whiting more commonly noticed ranged from about 7 to 10 inches. Most of the sand-eels were only half-grown specimens, but a few were adults, or nearly so, and were full of ripe or nearly ripe spawn. Other fishes which were observed, though somewhat sparingly, included brassies and *Gadus* (?) *esmarkii*, long rough dabs, small plaice, and the remains of herring.

## CRUSTACEA.

The crustacea comprised such forms as *Eupagurus bernhardus*, and *Eupagurus prideaux*, *Nephrops norvegicus*, *Hyas coarctatus*, *Portunus holsatus*, *Crangon almanni*, and the leg of a fairly large *Lithodes maia*, as well as the digested remains of *Lernæa branchialis* and other nondescript forms. A number of Schizopods (*Thysanoessa*) and *Euthemisto compressa* were also observed, but these were doubtless from the stomachs of some of the fishes swallowed by the halibut.

## CUTTLEFISHES.

Cuttlefishes occurred in no fewer than about 20 of the stomachs examined in February, and in about 13 of these they formed the only organisms present. The only species that could be determined were *Loligo vulgaris* and *Eledone cirrosa*, the remains being usually too imperfect for identification.



## March.

In March 1910, 83 stomachs of halibut were examined, and of these 68 contained food which could in some measure be determined, and, as in the previous month, this food consisted largely of fishes; crustacea were only sparingly met with, and very few cuttlefish were observed. The following proportions will show the nature of the food contents in the stomachs examined:—Fish remains only were found in 59 stomachs; crustacea only in 1; mixed fish, crustacea, cuttlefish, etc., in 9; and cuttlefish only in 1.

## FISHES.

The fishes observed were, as before, chiefly Gadoids and sand-eels. The only Gadoids satisfactorily determined were, for the most part, haddocks, whittings, *Gadus esmarkii*, and a three-bearded rockling (*Motella tricirrata*). Some of the haddocks and whiting were tolerably large fishes. One of the latter measured about 15 or 16 inches long (its earstones were 24 mm. in length), and one of the halibut about four and a half feet long was found to have swallowed a whiting about 14 inches in length, and two haddocks, one of which would be about 18 inches and the other 14½ inches (their earstones measured respectively 20 mm., 18·5 mm., 16 mm.). Such large fish, were, however, rather exceptional; smaller examples, ranging from 7 to 10 inches long, were more frequent. Specimens of what appeared to be *Gadus esmarkii* were observed on several occasions, but only the one specimen of *Motella tricirrata* was noticed.

Sand-eels, a few tolerably large, measuring from 7 or 8 inches, were not infrequent, and in one stomach the remains of twelve of them were found. There occurred in one of the halibut stomachs a small portion of the vertebra of an apparently large Gadoid; one of the joints measured across the long diameter 22 mm. and 19 mm. vertically (these measurements were made immediately after the specimen was removed from the stomach and before drying). The remains of herring were also observed, but they were of rare occurrence.

## CRUSTACEA.

The infrequency of crustacea in the halibut stomachs examined during March, when compared with some of the previous months, was somewhat marked. The species observed included *Portunus* sp., *Eupagurus bernhardus*, *Crangon allmanni*, *Galathea* sp., etc. In the stomach of one of the larger halibut a nearly complete female *Lithodes maia*, loaded with spawn, was obtained, the shell, claws, and legs of which were quite soft.

## CUTTLEFISH.

The contents of several stomachs consisted not only of fish and crustacea, but also sometimes of small cuttlefishes; the only specimens that in some measure could be determined were Octopods, apparently belonging to *Eledone* (*E. cirrosa*). In the stomach of a moderately large halibut were found the remains of a fairly large cuttlefish, but the only part that could be utilised for identification was a fragment of the anterior end of the "shell," which apparently was that of an *Ommatostrephes*, the shell of which is entirely different from that of any of the more common British cuttlefishes.

## April.

The number of halibut stomachs examined in April was 124; 40 of these were found to be empty, or their contents could not be identified, while the food in the remaining 84 was more or less recognisable.



Small and medium sized fishes, chiefly Gadoids, appeared to be the food mostly sought after by the halibut, and fully 60 of the stomachs examined contained nothing else. Crustacea, on the other hand, were only sparingly met with, and were usually associated with other kinds of food, such as small fishes, but cuttlefish remains were also occasionally present.

#### FISHES.

Fishes, as stated above, formed the principal part of the food of the halibut examined in April; haddocks and whittings were the species most commonly met with, and, though they were usually comparatively small, moderately large specimens were also occasionally obtained; generally, however, they were so much broken up by the digestive fluid that the accurate measurement of the fish itself was impracticable, but as the earstones were frequently found to be uninjured, a careful measurement of these always afforded a fairly correct indication of the size of the fish they belonged to. Their reliability as a guide to the approximate size of the fish has been frequently tested in the case of such species of haddocks, whiting, codfish, and some other Gadoids, and generally with satisfactory results.\*

Three fishes, all haddocks, were found in one of the halibut stomachs examined in April; their earstones measured 18 mm., 17 mm., 16 mm., showing that the first two were from 16 to 17 inches in length, and the third about 14 inches. In another stomach a whiting about 14 inches long and two haddocks about 17 or 18 inches respectively were observed, and the earstones of these three fishes measured—the whiting 20 mm., the larger haddock 18.5 mm., and the smaller 16 mm.; while in a third stomach, viz., that of a halibut over four feet long, were found the remains of a haddock over 18 inches in length (earstones 21 mm.), a moderately large flat-fish, the species of which was doubtful, and the jaws of a cuttlefish, probably an *Eledone*. Among other fishes met with in the stomachs examined in April were a few Norway pouts, *Gadus esmarkii*, a lemon sole, *Pleuronectes microcephalus*, the remains of a moderately large flat-fish that appeared to be a witch sole, *Pleuronectes cynoglossus*, and measured about 12 inches long, a considerable number of sand-eels, a smelt, *Osmerus eperlanus*, about nine inches long, a herring about 10½ inches long, and remains of others, and also a young piked dog-fish, *Acanthias vulgaris*, of moderate size; in this specimen the spine in front of the first dorsal fin measured from the base of the exposed (coloured) part to the tip about 20 mm.

#### CRUSTACEA

Crustacea were not very plentiful in the stomachs examined in April, and those met with were usually associated with other forms. The species observed were chiefly *Hyas coarctatus*, *Portunus* sp., hermit crabs (*Eupagurus bernhardus*), and *Nephrops*.

#### CUTTLEFISHES.

Cuttlefishes, or their remains in the form of dark horn-coloured jaws, were met with on several occasions. They all appeared to belong to the eight-armed group Octopoda, and those of them sufficiently perfect for identification were all apparently *Eledones*. Some of them were tolerably large, but accurate measurements were hardly attainable, as the delicate extremities of the tentacles were usually wanting, besides being otherwise injured. One that was tolerably perfect gave the following measurements:—Body to base of tentacles, 5¾ inches; length of tentacles, or at least what remained of

\* Cf. "Observations on the Otoliths of some Teleostean Fishes." *Twenty-fourth Annual Report of the Fishery Board for Scotland*, Part III., p 48-82, Pls. I.-IV.



them, 6 inches. This *Eledone*, therefore, would have measured over all fully 12 inches in length—a fairly big mouthful to swallow even for a moderate-sized halibut.

#### CETERA.

Some odd things observed included *Crangon allmanni*, discs of starfishes (*Ophiura*), small *Echinocardium*, fragments of Zoophytes, a small univalve shell (*Fusus*), and a few small stones. Most of these small things, however, were probably derived from the stomachs of the haddocks, whittings, &c., which the halibuts had swallowed.

#### May.

The number of halibut stomachs examined in May was 95, and of these 60 contained food which could, to some extent at least, be identified. The size of the halibut from which these stomachs were removed ranged for the most part from 30 inches to 42 inches in length. A few were from halibut under 30 inches, and a few others between 48 and 60 inches. The food found in 54 of the stomachs examined consisted entirely of fishes, chiefly Gadoids. Two contained crustacea only, and two the remains of cuttlefish only, while in two others were found the remains of fishes and shell-fish (*Buccinum*, sp.). From the results stated above, it would appear that in May halibut had been feeding more exclusively on fishes than during any of the previous monthly periods. Whether there is any natural cause for this change—whether, for example, it is due to seasonal influences affecting the supply of food, or merely to some accidental change—there is scarcely sufficient data to show.

#### THE FISHES OBSERVED.

The fishes met with in the halibut stomachs examined in May included, as usual, haddocks, whittings, sand-eels, and very rarely flat-fishes. Herrings were occasionally observed, a few of which were of fairly large size. In one stomach, for example, a herring of about 10 inches in length, and in another a specimen about 8 inches, were obtained. A witch sole about  $12\frac{1}{2}$  inches long was also found in one of the stomachs examined on May 6th. Some of the Gadoids were tolerably large; a whiting 15 inches long and a brassie (*Gadus luscus*) 13 inches were among some of the larger specimens met with.

The fish food in a considerable number of the stomachs examined in May was so much digested that if the earstones were absent the species was practically unrecognisable.

#### CRUSTACEA, CUTTLEFISHES, &c.

Crustacea and cuttlefishes were both very sparingly met with. *Hyas coarctatus* was almost the only crustacean observed, and the cuttlefish remains consisted chiefly of their dark-coloured horny jaws.

#### June.

The halibut stomachs examined in June numbered 119. Fifty-seven of them were empty or contained food that could not be identified, while the food in the remaining 62 consisted largely of gadoids. In 47 of the stomachs examined the food consisted entirely of fishes, and in fully 50 per cent. of them the food was so much digested that in many cases only a few bones were left, so that even the species could not be determined. The following Gadoids were recognised, viz.:—The remains of a codfish about 15 inches in



length, and another between 9 and 10 inches; the latter had a small flat-fish of doubtful species in its stomach. Haddocks were observed in seven or eight halibut stomachs, and whittings in about the same number. A *Gadus* (?) *luscus* about 9 inches long occurred in one stomach, and *Gadus esmarkii* in several. A few both of the haddocks and whittings were apparently tolerably large. The remains of fairly large herrings were also observed in three stomachs, and a small flat-fish—species doubtful—in one.

#### CRUSTACEA.

In ten of the stomachs examined in June, the food consisted entirely of Crustacea. *Hyas coarctatus*, the most common species, occurred in seven of them. The hermit crabs (*Eupagurus bernhardus* and *Eu. prideaux*) were only observed on one or two occasions, while Norway lobsters (*Nephrops*), so frequent during some of the previous months, were apparently entirely absent; so also were several of the other species met with during the winter.

#### CUTTLEFISHES.

Cuttlefishes were rarely met with in the halibut stomachs examined in June, and those observed were the remains of either small *Eledone* or *Octopus*.

#### ECHINODERMS.

A specimen of *Cidarus papillata*—a partly crushed test without spines—was obtained in one of the halibut stomachs examined in June.

Having in the preceding notes given a short descriptive account of the food-contents of the halibut stomachs examined from month to month from September 1909 to June 1910 inclusive, it may be useful if the various organisms referred to are brought together in the form of a more or less systematic list, as follows:—

#### A SYSTEMATIC LIST OF THE FISHES, CRUSTACEA, AND OTHER THINGS MENTIONED IN THE PRECEDING NOTES AS CONSTITUTING THE FOOD OF THE HALIBUT.

##### FOOD OF THE HALIBUT.

##### *Classified List of Organisms mentioned in the preceding Notes.*

##### *Fishes.*

*Agonus cataphractus*, Linné. The pogge.

A nearly perfect specimen, about  $4\frac{1}{2}$  inches long, obtained in January.

*Gadus callarius*, Linné. Codfish.

Remains of a moderately large codling observed in stomach of large halibut in November.

*Gadus aeglefinus*, Linné. Haddock.

Of frequent occurrence; some of the specimens tolerably large.

*Gadus merlangus*, Linné. Whiting.

Of frequent occurrence; some of the specimens tolerably large.

*Gadus pollachius*, Linné. Pollack or lythe.

*Gadus virens*, Linné. Coal-fish or saith.

Specimens that belonged to one or other of these two species have been occasionally observed, too imperfect to be satisfactorily identified.



*Gadus luscus*, Linné. The bib.

*Gadus minutus*, Linné. The poor or power-cod.

Specimens belonging to one or other of these Gadoids were occasionally met with, too imperfect to be satisfactorily determined. Their earstones are somewhat short and massive.

*Merluccius vulgaris*, Cav. The hake.

The earstone and other remains of a hake was found in the stomach of a tolerably large halibut in November. The hake would be between 15 and 16 inches long.

*Molva molva*, Linné. The ling.

A small ling, about 13 inches long, was obtained in a halibut's stomach in November.

*Motella (Onos) tricirrata*, Bloch. Three-bearded rockling.

A specimen of this species was observed in a halibut's stomach in March.

*Ammodytes (?) lanceolatus*, Le Sauv. Sand-eel or sand-launce.

Sometimes fairly common, especially in the stomachs of the smaller halibut.

*Drepanopsetta platessoides*, Fabr. Long rough dab.

A few examples, sufficiently perfect for identification, and measuring 5 to 6 inches in length, were obtained in November and January.

*Pleuronectes platessa*, Linné. Plaice.

Observed on two occasions, one specimen about 8 inches long in February, and another about 6½ inches in April.

*Pleuronectes microcephalus*, Don. Lemon dab or lemon sole.

Observed on two occasions; one specimen, length doubtful, in January, and one about 10½ inches long in April.

*Pleuronectes cynoglossus*, Linné. Witch sole.

A specimen about 12½ inches long was obtained in a halibut's stomach in May. The remains of what appeared to be another occurred in April, but too imperfect to be satisfactorily determined.

*Pleuronectes limanda*, Linné. Dab or common dab.

Only a single specimen observed.

*Osmerus eperlanus*, Linné. The smelt.

One specimen observed in a halibut's stomach in April.

*Clupea harengus*. Herring.

Herrings ranging in length from 7 to 10 inches were obtained in about a dozen of the halibuts' stomachs examined. A few of them appeared to have been feeding on *Thysanoessa* before being captured by the halibut.

*Acanthias vulgaris*. Spur-dog, piked dog-fish.

A young specimen from a halibut's stomach in April; the coloured part of the spine in front of the first dorsal fin measured from base to tip about 20 millimetres.

#### Crustacea.

*Hyas coarctatus*, Leach.

Observed on various occasions; specimens usually small.

*Portunus depurator*, Leach.

Sparingly met with on several occasions.

*Portunus holsatus*, Fabr.

Obtained only in three or four of the stomachs examined.

*Portunus pusillus*, Leach.

Obtained once in January along with *Hyas coarctatus*.



*Portunus arcuatus*, Leach.

Very rare in stomachs examined in January.

*Atelecyclus septemdentatus*, Mont.

This species occurred sparingly on one or two occasions.

*Corystes cassivelaunus*, Pennant.

This also occurred sparingly, but on one occasion a dozen small specimens in a stomach in January.

*Lithodes maia*, Linné.

Three small, fairly perfect specimens were obtained in a stomach examined in October, and a larger female carrying eggs, but with the shell soft and somewhat damaged, in one examined in February.

*Geryon tridens*, Kroyer.

A fairly large specimen of *Geryon* was found in one of the stomachs examined in October, and two smaller specimens in those examined in December.

*Eupagurus bernhardus*, Linné.

Tolerably frequent, especially in the winter months.

*Eupagurus prideaux*, Leach.

Obtained sparingly on two or three occasions.

*Eupagurus cuanensis*, Thomps.

Rare in one or two stomachs in December.

*Eupagurus pubescens*, Kroyer.

Fragments apparently belonging to this species occurred sparingly on one or two occasions in December.

*Galathea* sp.

Rarely met with, and only young or imperfect specimens.

*Munida bamffica*, Pennant.

*Munida* was not infrequent during the winter months. In one of the stomachs examined in October, 21 specimens, large and small—mostly small—were obtained, and 6 in another.

*Nephrops norvegicus*, Linné.

This crustacean was moderately common, especially during the winter months, not a few of the specimens being apparently adult; some of them measured 8 to full 9 inches to the end of the claws.

*Crangon allmanni*, Kinahan.

Rare, and probably derived from the stomachs of fish swallowed by the halibut.

*Pandulus montagui*, Leach.

Rare; observed only on one or two occasions.

*Thysanoessa neglecta*, Kroyer.

*Euthemisto compressa*, Goes.

Both of the species named were doubtless derived from the stomachs of sand-eels and herrings swallowed by the halibuts.

*Cirolana borealis*, Lilljeborg.

Several specimens were met with in one of the stomachs examined in October, probably having been swallowed with the Gadoids to which they were adhering as parasites.

*Lernæa branchialis*, Linné.

Fragments were observed on one or two occasions, having doubtless been fixed on the gills of Gadoids swallowed by the halibut.

#### Mollusca.

*Fusus antiquus*, Linné.

Two stomachs contained each an *operculum* only; another contained the head (with *operculum* attached) of a tolerably large specimen.



*Ommatostrephes todarus*, Delle Chiaje.

A small fragment of a cuttlefish shell, apparently belonging to this species, was obtained in a halibut stomach examined in March.

*Loligo vulgaris*, Lamarck.

Several specimens of *Loligo* have been met with, and though they may not all belong to the species named, one or two certainly do so.

*Eledone cirrosa*, Lamarck.

Specimens of *Eledone* were met with on several occasions, but other specimens were obtained which were scarcely perfect enough to determine the species. Cuttlefish jaws were also not uncommon, representing both large and small specimens.

#### *Echinodermata.*

*Spatangus purpureus*, O. F. Müller.

Fragments of the test of a *Spatangus* occurred in the intestine of one of the halibuts examined in September.

*Cidarus papillata*, Leske.

A partly-crushed test was obtained in a halibut's stomach examined in June.

*Ophiura* sp.

Several discs and fragments of arms were observed from time to time, but not identified.

#### CETERA.

Annelida were met with on one or two occasions, but appeared to be exceedingly rare in the stomachs of the halibut examined. Fragments of Zoophytes were also occasionally observed, and so also were small bits of stone. One piece of stone measured in millimetres 27 by 21 by 13, and its weight just under half an ounce avoirdupois.

#### NOTES ON THE FOOD OF *Scorpena dactyloptera*, *Belone vulgaris*, *Phycis blennoides*, AND *Chimaera monstrosa*.

*Scorpena dactyloptera*, De la Roche.

A considerable number of *Scorpena dactyloptera* were examined in February and March 1910, but the stomachs of about two-thirds of them contained nothing that could be satisfactorily determined. In one of the stomachs of the remainder was found a nearly perfect specimen of *Sepiola rondeleti*, Leach, and in another a small individual somewhat imperfect, which appeared to belong to the same species. Cuttlefish remains were found in other four, but were too imperfect to be satisfactorily identified, though from their appearance they were probably also *Sepiolas*. In the stomach of another of the same lot of *Scorpenas* were fragments of *Crangon*, apparently *C. allmanni*.

#### THE GARFISH OR SEA PIKE (*Belone vulgaris*, Cuvier).

A number of garfish captured in the North Sea, off the Aberdeenshire coast, in April and May, were found to have been feeding more or less extensively on small crustacea; both the stomach and intestine were in some instances filled with them. Eight tolerably large garfish, about 18 to 20



inches in length, had their stomachs filled with almost nothing else than pelagic Amphipods, which appeared to belong to *Parathemisto obliqua*, with a few fragments of some specimens belonging to the *Euphausiadae*, probably *Thysanoessa*. Everything the stomach contained, however, was so fragmentary that the species to which they belonged could not with certainty be determined. No other organisms besides those mentioned were observed.

*Phycis blennoides*. (Brun)—THE GREATER FORK-BEARD.

Stomachs, containing food, of about a dozen examples of the greater fork-beard (*Phycis blennoides*) from the Fish Market at Aberdeen were examined in February and the beginning of March 1910. They nearly all contained the partly-digested remains of small fishes, chiefly Gadoids. Though none of the specimens were perfect enough for satisfactory identification, it is probable that most of them belonged to *Gadus esmarkii*, as the form and structure of their ear-stones appeared to be practically identical with those of that species. In one stomach ten pairs of ear-stones were counted; three of the pairs were those of fishes about six inches long, while the others belonged to fishes of smaller size. One stomach contained a young piked dog-fish about 4 inches (100 mm.) in length, and another, a small lump-sucker (*Cyclopterus lumpus*). The crustacea were represented in these stomachs by *Nephrops norvegicus*, *Crangon* sp., *Pandalus montagui*, *Pandalina brevirostris*, and *Nyctiphanes*; there were also remains of crustacea that could not be identified. The only other organism observed was a small cuttlefish, probably an *Eledone*, but scarcely perfect enough to be satisfactorily determined.

*Chimæra monstrosa*.

In January 1910 a number of specimens of *Chimæra monstrosa* from the Fish Market were examined, and the food contained in their stomachs was found to consist of various organisms, comprising shell-fish, crustacea, Annelids, and Echinoderms.

SHELL-FISH.

The shell-fish included *Pecten tigrinus*, *Anomia* (?) *ephippium*, small *Fusus* sp., small *Buccinum undatum*, *Cardium fasciatum*, and *Scalaria* sp.

CRUSTACEA.

The crustacea comprised Decapods, such as *Ebalia* sp., small *Hyas coarctatus*, small *Eupagurus*, and Amphipods, such as *Hippomedon denticulatus* and *Ampelisca* sp.

ANNELIDS.

Several fragments of Annelids occurred, but the species could not be made out.

ECHINODERMS.

The only species of Echinoderm identified was *Echinocardium cordatum*; the remains consisted of spines and fragments of tests.









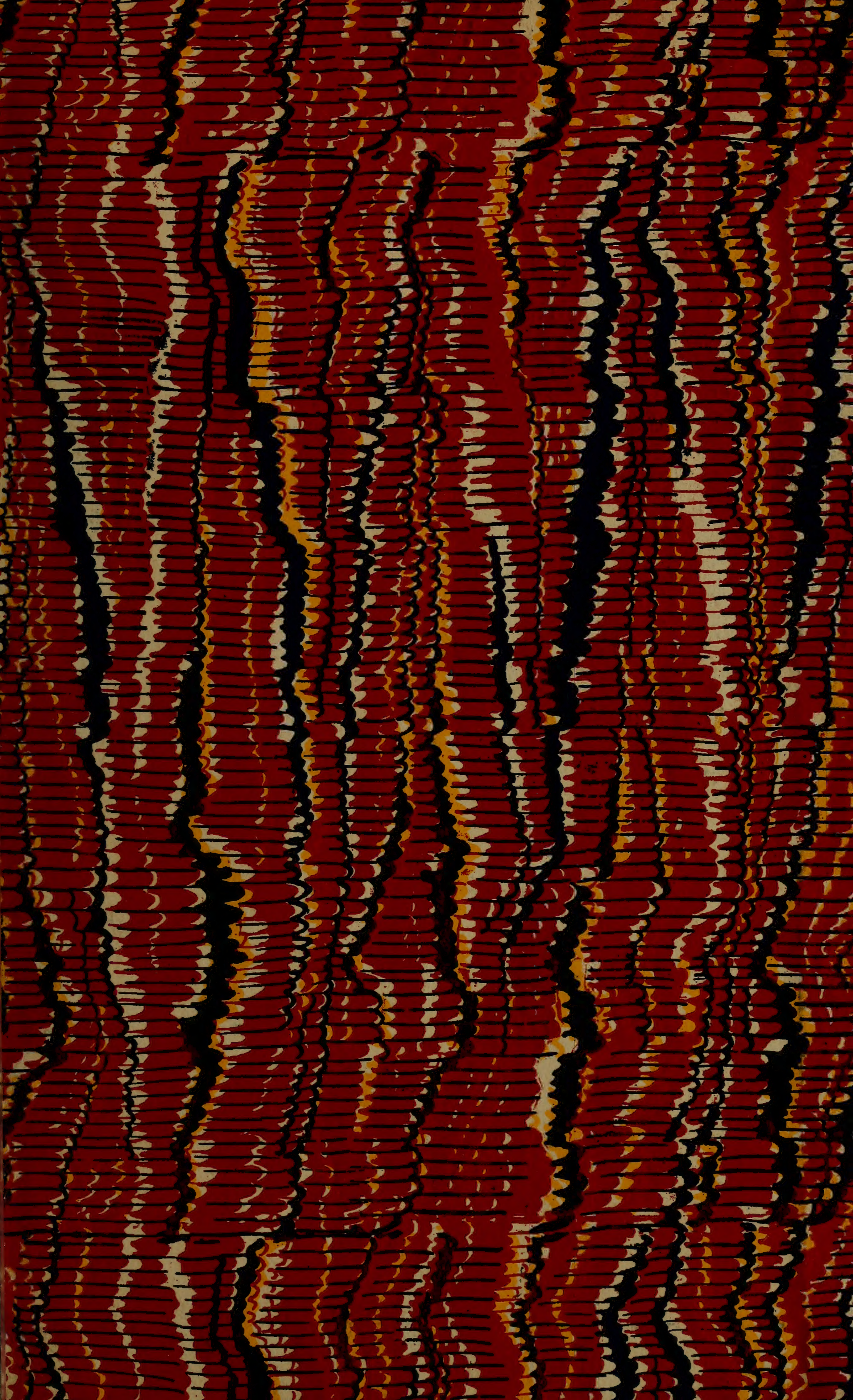






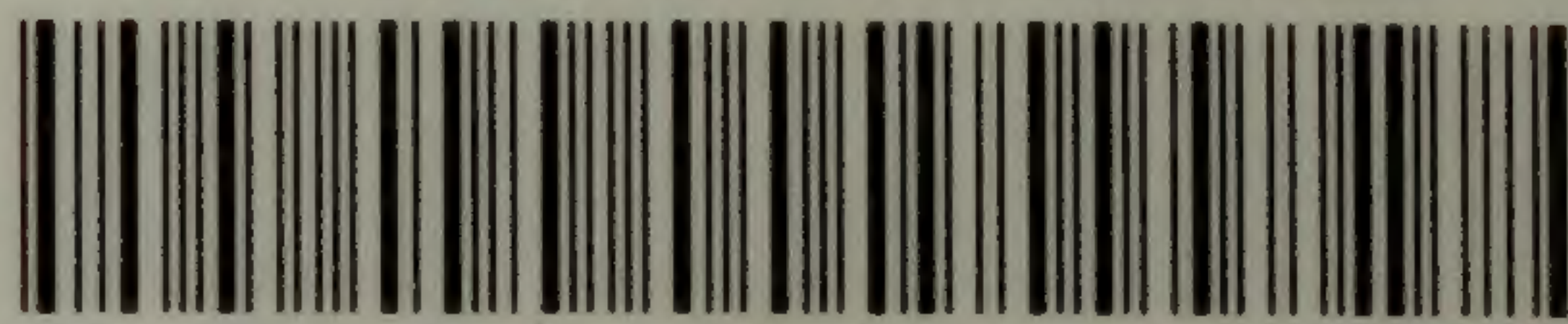








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